Space Weather Technical Forecast

Issued on Saturday, 27 April 2024 at 13:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Declining chance of M-flares and slight chance of X-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity is currently Low, with only C-class flares in the last 24 hours. There are currently nine sunspot regions on the visible disc. The sunspot cluster in the southwest has now rotated beyond the west limb, with a rapidly declining influence on the flare forecast. AR3654 near centre disc has shown significant growth recently, apparently with a new region appearing in the middle of the existing region. An area in the middle of the group is developing into a delta spot. AR3658 in the southwest has shown further development, with a few intermediate spots emerging. AR3660 has recently rotated around the east limb, although it is difficult to get a detailed analysis at present due to foreshortening. Remaining sunspot regions are all relatively small, simple and stable.

A new CME has been observed starting around 26/1830 UTC, which emerged from an area of plage in the southeast of the disc, and was likely also associated with a filament eruption. The resulting CME is mostly passing behind and below Earth's orbit, but there is a slight chance of a glancing blow early on Day 4 (30 Apr).

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 have shown the onset of a HSS, perhaps combined with some weak CME influence. Wind speeds started at background levels but rose to become elevated, from around 330 km/s to near 500 km/s. Density has been average or below. The Interplanetary Magnetic Field has been mostly Moderate, but with some brief Strong peaks around 17nT between 27/0400-0630 UTC. The north-south component, Bz, was moderately negative, reaching -11nT at first, becoming more variable after 27/0400 UTC. Phi angle was mostly positive (away from the Sun) after 26/1500 UTC. Geomagnetic activity started the period with G1/Minor Storm (Kp 5) intervals between 26/1200-1800 UTC, before declining to be Quiet to Unsettled.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The associated 24-hour fluence showed a declining trend below the Active threshold, with 3.51e6 integrated pfu observed at 27/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of M-flares and a slight chance of X-flares, this risk decreasing slightly into Day 2 (28 Apr) as the cluster which was in the southwest rotates well away from the limb.

Solar Wind / Geomagnetic Activity: There is a declining risk of further CME arrivals from ex-AR3638 as it has now rotated over the west limb. There is, however, a new CME which could give a glancing blow early on Day 4 (30 Apr). There is a series of coronal holes in the form of CH27, 30 and 29, with the initial High Speed Stream (HSS) now having arrived at L1. Wind speeds are expected to be at elevated levels of 500-550 km/s through much of Days 1 and 2 (27-28 Apr), before gradually declining thereafter, but with some uncertainty in how fast the wind speeds will decline.

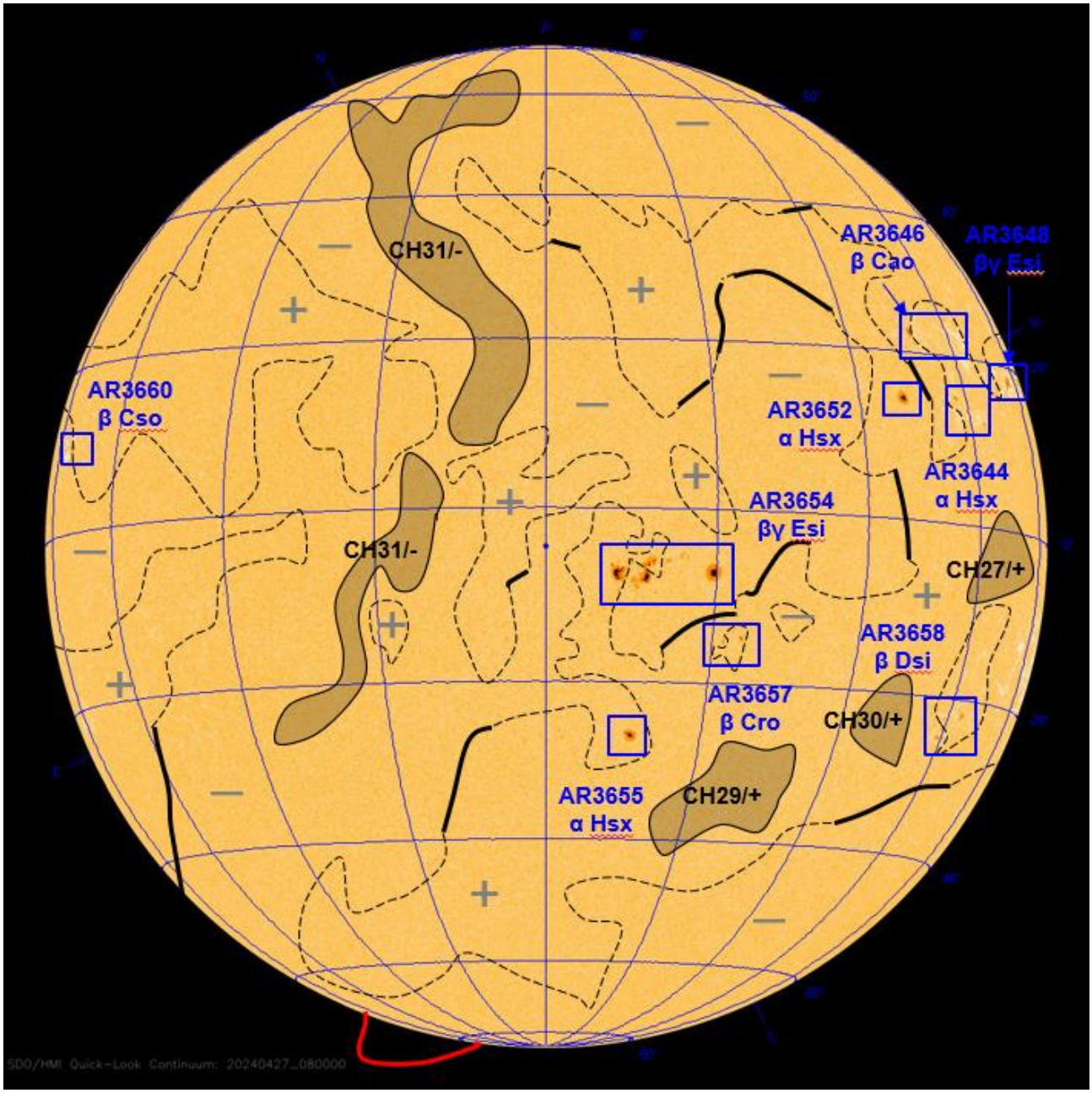
Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with a

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

slight chance of Active to G1/Minor Storm intervals, mainly on Day 1 due to a combination of HSS and potential CME influence, and again on Day 4 due to a possible CME glancing blow.
Energetic Particles / Solar Radiation: High energy proton flux is likely to remain at background levels, but with a decreasing slight chance of reaching the S1/Minor Radiation Storm threshold, as the sunspot cluster which was in the southwest rotates well away from the limb.
High energy electron flux is likely to be suppressed at GEO initially, perhaps increasing later in the period as CME and HSS influences wane. There is a slight chance of fluence reaching the Active (1e8 integrated pfu) threshold during Days 3 and 4 (29-30 Apr).

Figure 1. Solar Analysis Valid 27/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms:

There have been numerous CMEs released in the past week or so, mainly from ex-AR3638, which have likely mostly passed by Earth, although at least one such CME has arrived in the last couple of days. However, it is not possible to ascribe this to any one outstanding event, but there is a declining risk of further arrivals from this source as it has now rotated over the west limb. There is, however, a new CME which starting around 26/1830 UTC emerged from an area of plage in the southeast of the disc, and was likely also associated with a filament eruption. The resulting CME is mostly passing behind and below Earth's orbit, but there is a slight chance of a glancing blow early on Day 4 (30 Apr).

The fast wind-based forecast is of slightly higher confidence compared to the transient story, with a series of coronal holes in the form of CH27, 30 and 29 making themselves felt in the period, with a successively reducing likelihood as they lie progressively further south on the disc and further from the ecliptic plane. The initial High Speed Stream (HSS) has now arrived at L1, with speeds expected to be at elevated levels of 500-550 km/s through much of Days 1 and 2 (27-28 Apr), before gradually declining thereafter. There is some uncertainty in how fast the wind speeds will decline, given the increasingly southward location of these coronal holes on the disc. With the polarity being positive, impacts are most likely to be muted at this time of year.

Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with a slight chance of Active to G1/Minor Storm intervals, mainly on Day 1 due to a combination of HSS and potential CME influence, and again on Day 4 due to a possible CME glancing blow.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	10	5	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

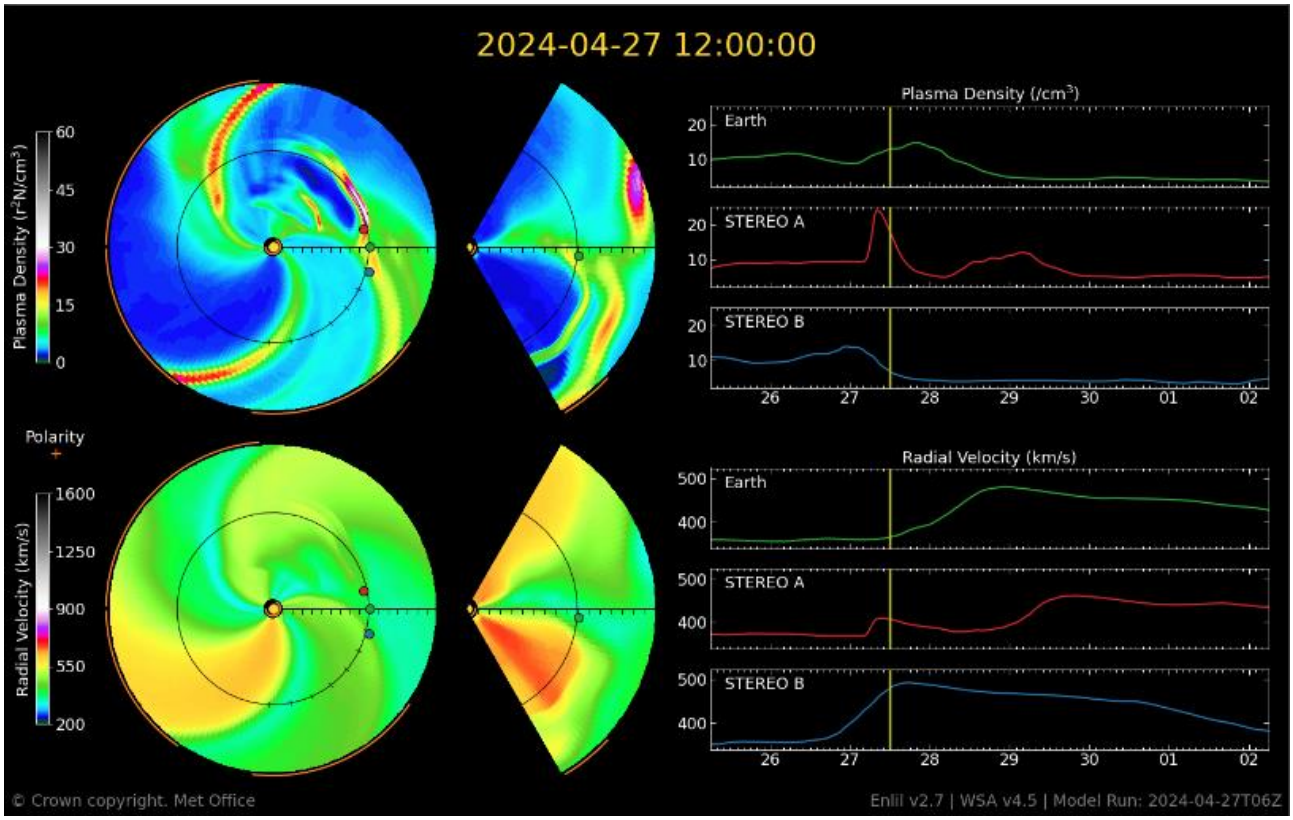
Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/0402	Partial	Filament	SE	472 km/s	30/1200 UTC	Glancing blow possible

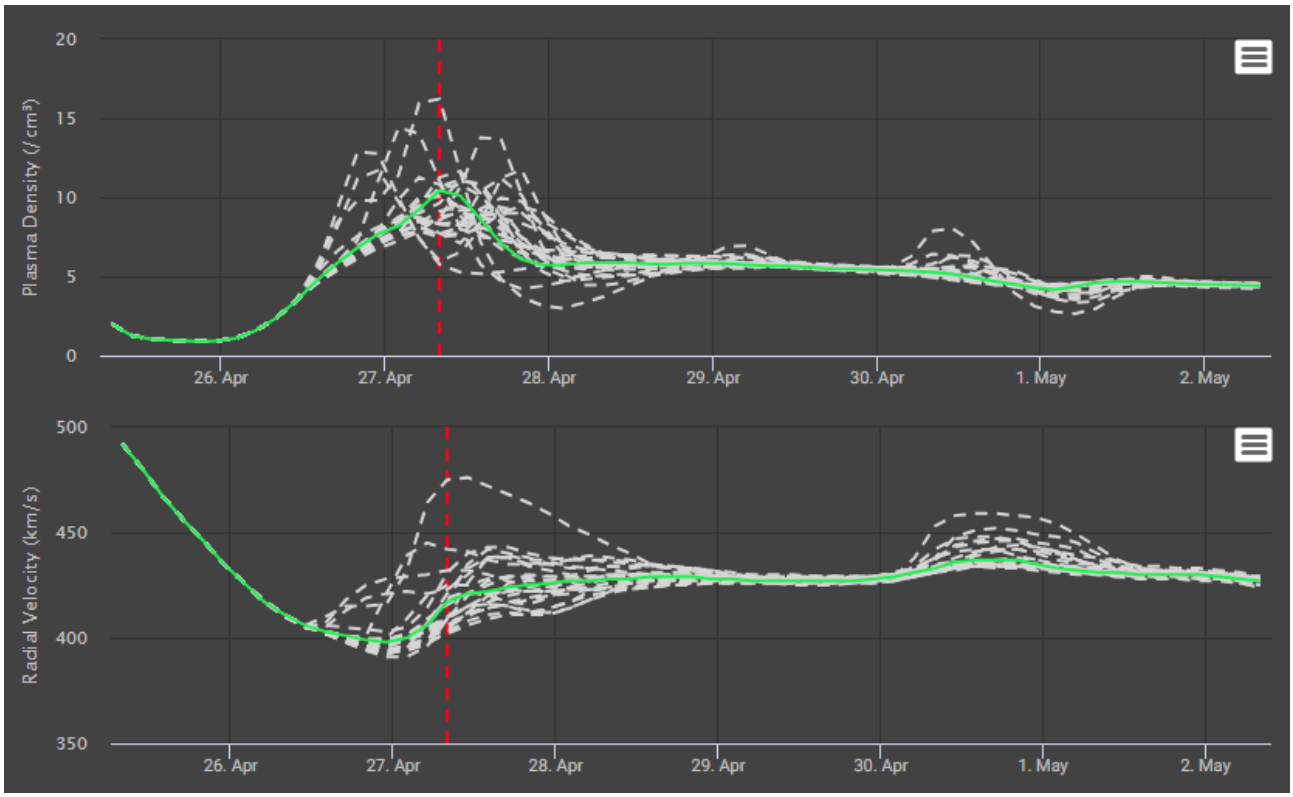
There is also a declining risk of CME arrivals during Day 1 (27 Apr) from the series of CMEs pushed out by ex-AR3638, now over the southwest limb.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: MOSWOC Enlil and ensemble, showing potential glancing blows and ongoing HSS.





Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

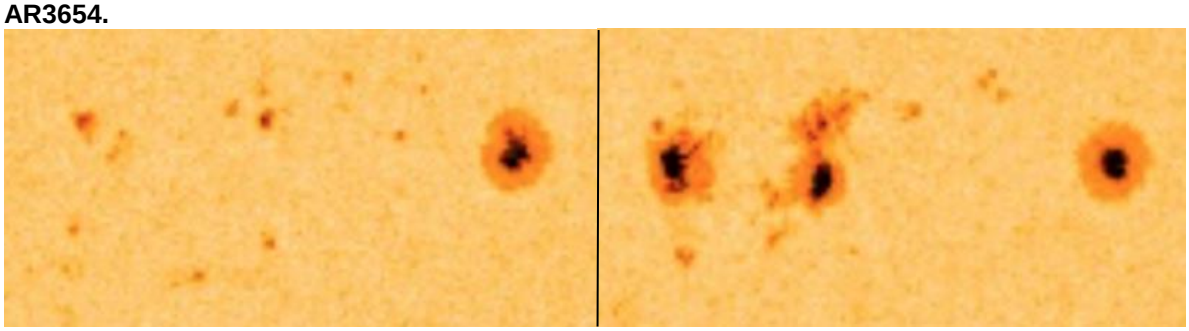
© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
There are currently nine sunspot regions on the visible disc. The sunspot cluster in the southwest has now rotated beyond the west limb, with a rapidly declining influence on the flare forecast. AR3654 near centre disc has shown significant growth recently, apparently with a new region appearing in the middle of the existing region. An area in the middle of the group is now developing into a delta spot, and there has been an increase in associated flux. This region is responsible for an uptick in flare probability compared to the previous guidance through the latter part of this period. AR3648 in the northwest is becoming difficult to analyse as it rotates closer to the west limb. AR3658 in the southwest has shown further development, with a few intermediate spots emerging. AR3660 has recently rotated around the east limb, although it is difficult to get a detailed analysis at present due to foreshortening. Remaining sunspot regions are all relatively small, simple and stable.

Far-side helioseismographs show a relatively large signal covering a large portion of the far-sided eastern hemisphere, although there is relatively little expected in this location from persistence. This remains something to be monitored for any increase later in the four days, however for now no significant regions are expected. Overall, there is a chance of M-flares and a slight chance of X-flares, this risk decreasing slightly into Day 2 (28 Apr) as the cluster which was in the southwest rotates well away from the limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	40	40	40
Very Active	R3 to R5 X Class	No	10	5	5	5

Figure 3: SDO intensitygram, from 26/1215 UTC (left) and 27/1145 UTC (right), showing the growth of AR3654.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
High energy proton flux (greater than 10MeV) observed at GOES18 has been at background levels, and is most likely to remain that way through this period. However, the cluster of spots which has now rotated over the southwestern limb has the potential to cause an increase in proton flux until it reaches around 120W, late on Day 2 (28 Apr).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

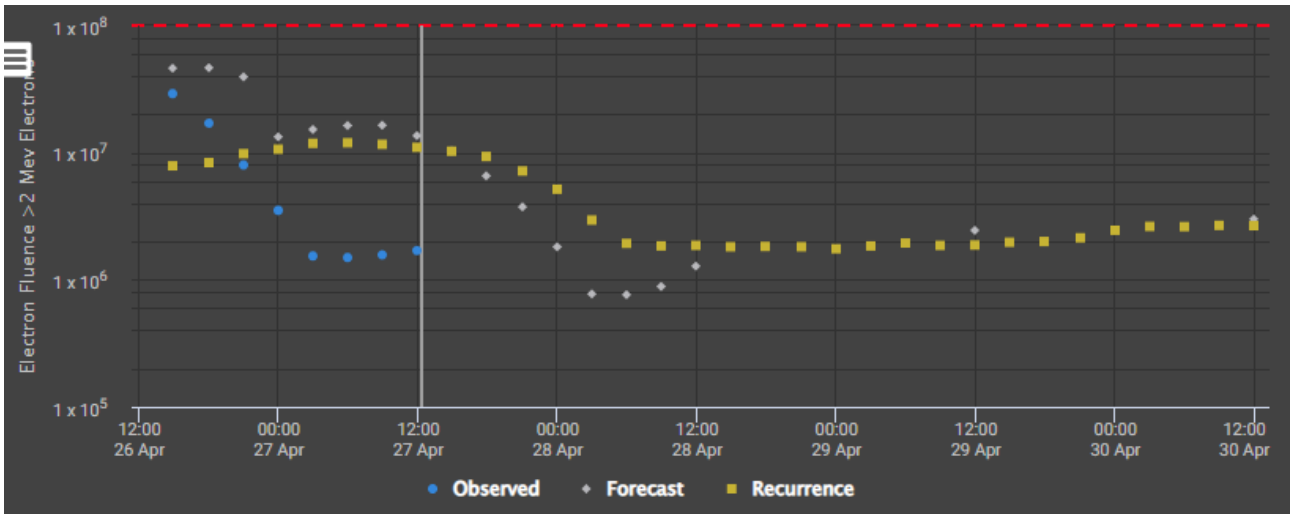
© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):
High energy electron flux is likely to be suppressed at first at GEO by the current combined CME and HSS influence. However, this HSS has the potential to cause an increase in electron flux below GEO, which could then reach GEO from Day 3 (29 Apr) onwards as the wind speeds start to ease. However, the potential for another CME glancing blow on Day 4 (30 Apr) could then cause a further suppression, so confidence is low.

The 24 hour integrated electron fluence is likely to remain well below the Active (1e8 integrated pfu) threshold at first, perhaps with a rising trend later in the period. MOSWOC REFM is currently forecasting fluence to remain well below the Active level, but this may change as it ingests the most recent higher wind speed data.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM, showing a below Active trend.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.